RESEARCH HIGHLIGHT

May 2009 Technical Series 09-104

The Northern Sustainable House: An Innovative Design Process

INTRODUCTION

In 2006, Canada Mortgage and Housing Corporation (CMHC) collaborated with the Nunavut Housing Corporation (NHC) in Nunavut and the Tr'ondëk Hwëch'in First Nation in the Yukon to design two examples of the Northern Sustainable House.

The project had two objectives: to promote the design of culturally appropriate housing across the North, and to construct housing that consumes 50 percent less energy than similar housing constructed to the Model National Energy Code for Houses (MNECH).

While the technical specifications built upon existing models of housing being constructed in the communities, the cultural goals necessitated exploring many new ideas, and taking a variety of local community concerns into account. Meeting this unique challenge required extensive discussions with builders and residents in the locations where these houses were proposed: Arviat, Nunavut, and Dawson City, Yukon.

In September and October 2006, as part of the design process, representatives of CMHC organized and facilitated design charrettes with residents of the two communities as well as representatives of the territorial housing and local housing agencies.

In the charrettes (multidisciplinary design planning meetings), participants discussed major issues, identified goals, and explored strategies. The intention was that this visioning process would result in innovative and improved housing models for each of the communities.

The Integrated Design Process

The Integrated Design Process (IDP) is a holistic approach to building design. Led by a facilitator, it brings together all of the building's stakeholders including designers, property managers, builders, technical experts, municipal representatives and, for residential buildings, prospective residents to discuss their interests and ideas. In a series of sessions, an IDP team considers technical issues such as site, climate, building form and space planning, building envelope, energy efficiency, renewable energy potential, mechanical and electrical systems, as well as user preferences. In the Far North, this includes a strong focus on addressing the unique social and cultural issues of northern communities. Developing consensus is an essential part of the process.

Charrettes are a key ingredient in the IDP, serving as effective forums in which participants are encouraged to think in positive and innovative ways about sustainable building design and construction. They also provide a creative environment where diverse skills, expertise and personal interests can be brought together to contribute new perspectives on issues in order to develop new solutions.

In Aboriginal communities, where the cultural values and collective identity of the group are important, the IDP is slightly different. In these communities the identification of community cultural values and needs is as prominent and important a goal as the examination of building performance. Participants are directed and encouraged to consider social and environmental factors as thoroughly as the physical, technical construction elements.

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Through integrated thinking about housing, community and sustainability issues, the IDP can contribute to an improved sense of community ownership and connection with the project being considered, and ultimately to reduced building and operating costs.

Results of the community consultations

Using the output from the discussions during the charrettes, CMHC partnered with the housing providers in each of the two communities to develop designs for affordable, high-quality housing. Two models of the Northern Sustainable House prototype were developed:

- A model for Inuit communities in the eastern arctic (above the tree line), in partnership with the Nunavut Housing Corporation (NHC), in Arviat, Nunavut.
- A model for the western arctic (below the tree line), in partnership with the Tr'ondëk Hwëch'in First Nation, in Dawson City, Yukon.

To carry out the work, a design and review team, led by CMHC, was established for each project. Design options were explored, alternative construction systems designed to attain the targeted energy goals were developed, and the energy performance of each house was modeled.

ARVIAT CHARRETTE AND HOUSE DESIGN

The Arviat charrette (Figure 1) was originally planned as a one-day discussion involving all parties. When technical issues began to dominate the opening session at the expense of exploring important cultural issues, it was decided to hold a separate one day session to explore technical issues and ensure that technical details and related architectural issues would be thoroughly addressed. When it was recognized that women of the community were underrepresented in these sessions, a third session was organized to focus on the perspectives of women and their housing needs.

Much of the attention in the specialized technical session was given over to issues related to water (including water supply, sewage trucking and disposal), the challenges of building more energy efficient housing and technical details such as the construction of foundations in the permafrost conditions of the far north. Other factors were discussed included energy efficient appliances, mechanical systems, and lighting. Participants zeroed in on a number of areas that were felt to be insufficient in current housing and which needed improvement. These included issues such as the number of bathrooms, storage capacity, the sizes of kitchen counters and sinks, as well as issues with door knobs, cabinets, steel doors, ventilation and light switches.

Figure 1 The Arviat House Design Charrette

In the sessions with elders and women of the community, time was taken to consider the adequacy and inadequacy of existing house design from their particular points of view. Many of the points they stressed were related to the adjustments the Inuit had to make when they changed from being nomadic peoples, with different summer and winter shelter, and moved to communities with year-round houses in one location. They talked about changes in Inuit family structures and activities and the way southern housing rarely accommodated their needs for storage space and for a place to sew and work on skins. Participants were particularly concerned that houses should be able to accommodate large family gatherings.

Following the design charrette, a design team combining CMHC and NHC expertise produced a house design that addressed the ideas and recommendations of charrette participants. In developing the design, the team combined Inuit tradition, the technical requirements explored in the charrettes and built upon some innovative building practices already being used in Nunavut. For example, the NHC, with the technical assistance of CMHC, had previously worked out the design for a five-plex housing complex that would use 25 percent less energy than a similar house built to the MNECH.

The house design, developed by the CMHC/NHC design team, included developing and evaluating two alternative energy efficient wall systems for the house. An external consultant, hired to evaluate the energy performance of these walls, determined that both wall systems would meet the energy performance goals of the project: a house that would consume only 40% of the energy of a similar house designed to the MNECH. Anticipated energy costs for the houses constructed with the selected walls will be considerably less than for houses built to MNECH specifications.

As part of the IDP, the house design was presented to the original charrette participants and the NHC for comments, which were incorporated into a final design. Participants generally acknowledged that the house effectively addressed the needs of the Inuit family. From these consultations, a final design that incorporated the input from the participants and the needs of the NHC was developed (Figure 2).

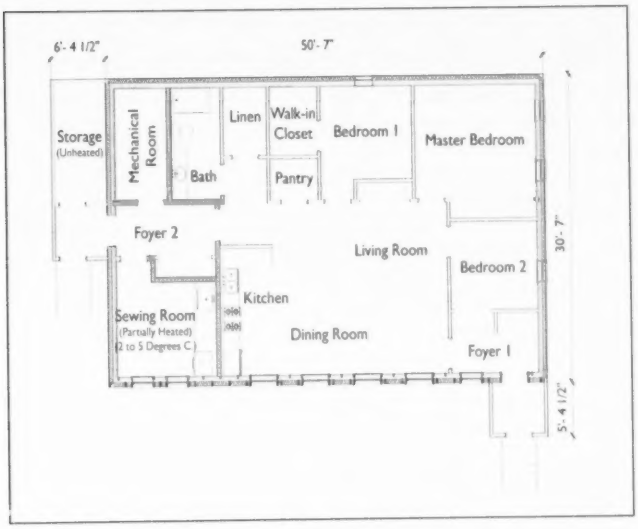

Figure 2 Floor Plan - NHC/CMHC Northern Sustainable House

To address cultural needs, the NHC/CMHC Northern Sustainable House design includes a large storage area, a cool room for sewing skins, and a large open kitchen/living area for family gatherings, with bedrooms located immediately off of this open area. The house is designed to maximize solar gain by orienting the majority of windows to the south, and by providing a large vertical area for solar panels (Figure 3). The form of the building is designed to deflect the cold northern winds. The house has summer and winter entries. The winter entry, located on the west elevation to allow the wind to keep the area free of snow, is designed and constructed with an air lock.

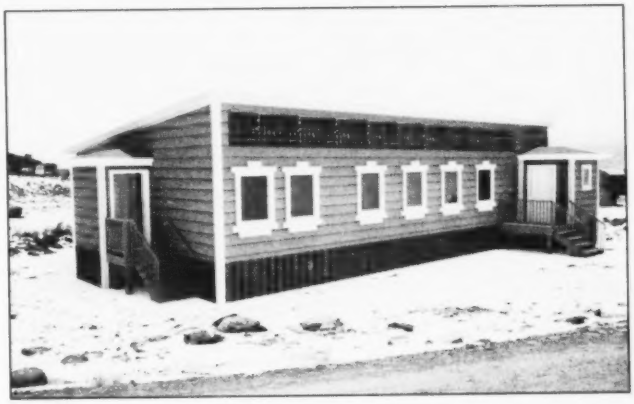

Figure 3 Perspective - The NHC/CMHC Northern Sustainable House

DAWSON CITY CHARRETTE AND HOUSE DESIGN

Contemporary housing for the Tr'ondëk Hwëch'in First Nation include historical and construction features that are unique to Dawson City. For example, in terms of design, Tr'ondëk Hwëch'in First Nations housing, like the housing in the community of Dawson City, is the only place in the north where porches are commonly used on the front of houses. In terms of construction, the new housing in C2, a new Tr'ondëk Hwëch'in subdivision, are being built on a relic of the gold rush, the deep layer of dredged river rock that covers much of the valley. This feature, which moves the permafrost layer many feet below the surface allows for the construction of shallow concrete foundations with uninsulated crawlspaces. By contrast, away from the Yukon and Klondike rivers—far from where dredging for gold took place during the Yukon Gold Rush—permafrost is near the surface.

The design charrette (Figure 4) held in Dawson City built upon the experience of Han Construction, the local construction company of the Tr'ondëk Hwëch'in First Nation. The company, experienced in the design and construction of both flex housing and energy-efficient housing, has been consulting with residents for a number of years, and altering floor plans to suit the needs of residents.

As a result, the discussions did not present radical challenges, either for the company, or for the other participants.

With this background, the participants in the house design charrette were able to pinpoint what they felt were deficiencies in existing housing. While they noted that current housing generally meets local community and family needs, participants offered a number of perspectives and opinions about areas where they thought improvement was needed.

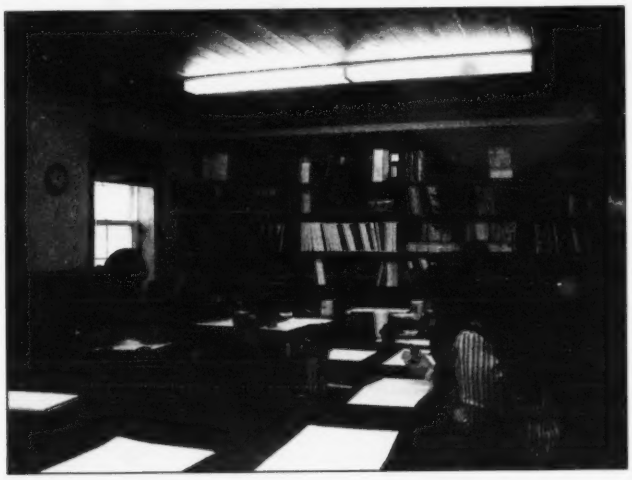

Figure 4 Participants Sketch Ideas at the Dawson City House Design Charrette

Notably among these areas, participants mentioned the limitations of lot sizes and the constraints resulting from lot placement, the possibility of using alternative materials and building systems, the potential for innovative mechanical heating and ventilating systems, the need for more storage space, and for a variety of floor plans and flex options to accommodate changing needs of occupants. In addition, charrette participants felt that a number of non-architectural elements should be considered in the design of new housing. These included the need for shading in summer and for windbreaks in winter, as well as consideration of the effects of reduced family size, evolving family dynamics, and affordability.

A CMHC-led design team developed a house design that refined the features already being used by Han Construction that included an open room for family gatherings, and a large covered deck that could be easily turned into additional living space (Figure 5). The new design expanded the open living area, added a southern orientation for passive solar gain and included an alternative heating system, featuring a boiler and wall mounted radiant units. A Heat Recovery Ventilator (HRV) was specified to provide fresh outdoor air and to vent stale air, moisture and odours. The development of the designs and construction details for the project involved ongoing meetings and consultations between CMHC and Han Construction.

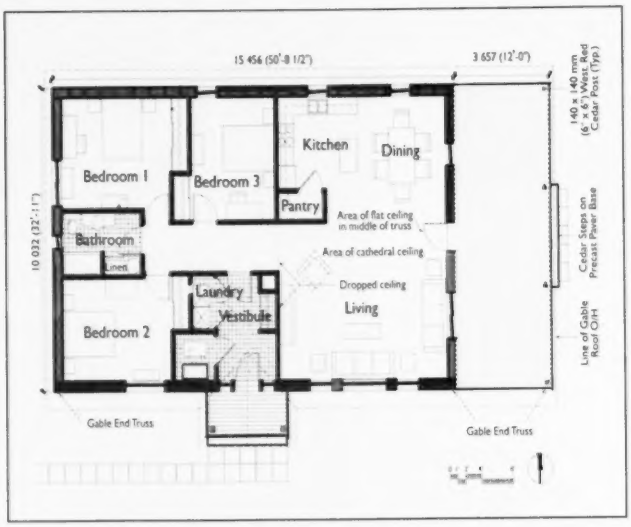

Figure 5 Floor Plan - The Tr'ondëk Hwëch'in/CMHC Northern Sustainable House

To meet the energy performance targets, two alternative wall systems were designed and evaluated by the external consultant. Both wall systems and the planned house design met the energy performance standards of the project, the target of using 50 per cent less energy than a similar house designed to the MNECH.

The final design was presented to the Tr'ondëk Hwëch'in, who were pleased with the design. Charrette participants spoke favourably of the large open living space, combining the kitchen, dining room and living room and the porches, which could be easily converted into living space (Figure 6).

CONCLUSIONS

The Northern Sustainable House is an example of the innovative thinking about energy-efficient design that is taking place in Canada's arctic and sub-arctic regions. As a result of the charrettes in Arviat and Dawson City, affordable, culturally sensitive, energy-efficient housing has either been constructed or is planned in these communities.

Both goals set for the project were satisfied. Charrette participants unanimously agree that their discussions led to housing designs that better meet their cultural needs. In addition, modeling has demonstrated that these designs will reduce energy needs far below energy consumption targets of the Model National Energy Code for Houses in arctic and sub-arctic regions.

Figure 6 The Tr'ondëk Hwëch'in/CMHC Northern Sustainable House

Perhaps just as significantly, residents of both communities were impressed by the process that led to the house design. Those who participated in the charrettes spoke glowingly about how they had been allowed to contribute their opinions and knowledge about the housing features they valued. Many of them said that this was the first time a government agency had ever asked for their opinions regarding their housing needs. A year after the process, they were still grateful that they had been asked to help design housing for their community.

To the Inuit especially, consensus is an essential element of community work. The three-day charrette in Arviat gave elders and women a chance to work alongside technical staff to reach a common goal. They considered the process to be a success as soon as it became clear that they would be able to voice their concerns openly and that they would be taken seriously.

CMHC, the housing corporations, and local residents are all satisfied with their part in contributing to a cooperative process that strengthened northern communities as it refined and improved northern housing design. Representatives of the Nunavut Housing Corporation and the Yukon Housing Corporation, local participants in the charrettes, and management of Han Construction recognize the value of the process that led to the Northern Sustainable House.

At the same time, they realize that the Northern Sustainable House is not the ultimate in energy efficiency. Participants in Dawson City were adamant that, given more time, they could have come up with more appropriate housing for the north. They view this project as only one step forward on a road that stretches far into the future, and they are determined to keep on trying.

CMHC hopes that both the Integrated Design Process and the results of this project will prove to be useful far beyond the two communities involved, both above and below the tree line, from Yukon and the Northwest Territories to Nunavut.

CMHC Researcher: William Semple

Housing Research at CMHC

Under Part IX of the ***National Housing Act***, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This fact sheet is one of a series intended to inform you of the nature and scope of CMHC's research.

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or contact:

Canada Mortgage and Housing Corporation
700 Montreal Road
Ottawa, Ontario
K1A 0P7

Phone: 1-800-668-2642
Fax: 1-800-245-9274

Printed in Canada
Produced by CMHC 04-05-09

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